Chapter 6
Communication and Information Systems Equipment

Section I
Cold Weather Problems

PHENOMENA

Certain climatic conditions affect communications and communications equipment in cold regions. These include: cold temperatures associated with dry air, condensation resulting from relatively rapid temperature changes, frozen surfaces, snow and ice, visibility, and electromagnetic conditions.

Cold-Dry Air

In cold-dry air, cold-soaked equipment is especially difficult to assemble. Increased attention to detail, patience, and special preparation to prevent damage is required. This includes working with tight connections, electrical contacts, inflexible cables, power cords, grounding, control knobs, rubber covers, binding posts, and other moving parts. Assembly of equipment is also complicated by the bulky gloves or mittens worn by operators and maintainers.

As mentioned in Chapter 1, cold markedly lessens the operational life of batteries. At -40°F the storage battery for the radio sets SINCGARS cease to operate, resulting in lost codes, and requiring reloading after rewarming. The dry air, coupled with the wind and cold, can cause considerable buildup of static electricity on nonconducting surfaces. This buildup can be a hazard to operators and technicians, as well as to equipment. Temperature inversions that occur on the coldest days in cold regions degrade frequency modulation (FM) communications signal strength drastically. This must be considered when planning troop dispositions and locations of command and control centers.

Condensation

Rapid changes in relative temperature cause cold-soaked equipment to sweat and frost up when moved rapidly between warmth and cold. Electrical contacts are especially susceptible. Also, frosting from the breath of the operators can render microphones inoperable.

Frozen Surfaces

Frozen surfaces serve as heat sinks and rapidly cool equipment. A good rule is to keep all communications equipment off the ground. Adequate grounding is important on many pieces of communications equipment, yet is very difficult to achieve on frozen surfaces.

NOTE: Standard grounding systems will require considerable effort to construct, and in some cases prove to be impossible. Shaped charges, coupled with water-saturated salt/soil backfill poured over the grounding device, provide one of the best means for penetrating frozen earth.

Extraction of grounding devices is more than likely possible only after seasonal thawing. Use of existing grounds (pipes, established grounds, and buried steel) is desirable, as long as the pipes are not conduits for gas or flammable liquids.

Snow and Ice

Snow and ice can get into any unprotected openings in equipment. Use the equipment covers provided for most communications equipment. Signal attenuation due to ice on antennas is also

common in cold regions. Drip loops for overhead connections, especially power connections, are required. Since small items dropped in the snow are easily lost, more frequent inventory of sets and kits is advised.

Visibility

Prolonged hours of darkness affect communications equipment operation and maintenance in several ways. Inventory, assembly, and disassembly in the dark are difficult and time-consuming, especially when wearing required gloves or mittens. High frequency (HF) wave propagation markedly deteriorates with changes occurring in the ionosphere as darkness approaches. Lower frequency assignments that need longer antennas are also required. A good day of HF communications between stations 100 kilometers or more apart might be limited to only six hours.

Electromagnetic Conditions

The Aurora Borealis activity can cause noise, suppress signals, and cause unusual wave propagation in radio communications. While electromagnetic interference does not damage equipment, planners must anticipate this degradation in choosing unit locations. Fading and severe static can cause speech secure devices, such as the KY-7, to lose signal, requiring numerous retransmissions of long messages.

Units reportedly use Aurora activity to gain greater range for HF radio by reflecting directional signals off the light fields. However, this innovative use of conditions is the exception. The greater magnetic declination angles encountered as one moves farther north also greatly affect radio communications positioning and orientation of directional antennas. These problems increase the need for strict supervision.

The most effective tactical ground system for use in frozen ground is the Surface Wire Ground System (SWGS). This system consists of pins connected together with cable to form a grounding grid. Typically, the best grounding that can be obtained with either a six-foot grounding rod or the SWGS is about 3,000 ohms of resistance.

Section II
Operation and Maintenance of Communications and Information Systems

RADIO SYSTEMS

Several considerations for radio equipment were addressed in the previous section. A good rule to follow and enforce is to handle all communications/electronic equipment very carefully when cold. A radio dropped on cold ground or thrown into the back of a vehicle is easily damaged. Control knobs may be sluggish or even frozen and require careful handling.

Even well-maintained equipment requires considerable warmup time. For example, 15 to 20 minutes warmup before voice transmission may be required, and a cold-soaked AN/GRC-42 radioteletype system might require warming for three to four hours. Keeping equipment as warm as possible can be achieved with careful planning and innovation. Use chemical heat pads and styrofoam to keep equipment, especially speech secure devices, operational. Placement of radios and switchboards off the ground and away from exterior tent or shelter walls is advisable.

Another hazard is, ironically, too much heat. Needless damage to equipment is often incurred by improperly placing the equipment too near shelter heat sources, such as a stove or heater. Electronic components and insulators can easily melt or burn, and some

batteries explode when thawed too close to a heat source.

Lithium batteries, like the BA-5598 for the radio set SINCGARS, are especially effective in cold weather and do not need warming at temperatures above -20°F. Dry cells should be kept warm until needed. Extra batteries can replace cold batteries in use; after warming, they can be used again. Batteries should not be installed in idle equipment. Plastic pins on battery connections get brittle in the cold; install them carefully.

Each user of a portable manpacked radio should carry the handset inside at least one layer of clothing to prevent the push-to-talk button from freezing. This requirement, combined with the operator wearing a parka hood, severely hampers the ability to hear incoming transmissions. This may be overcome by using external speakers such as the LS-454/U. Use plastic coverings, such as battery packaging, to cover the mouthpieces of handsets. These should be used even with the presence of moisture shields to keep moisture from the operator's breath from freezing the handset. An excellent alternative is the standard nonlubricated prophylactic slipped over the handset. A wool sock over the handset keeps snow and ice out and protects the operator from direct contact with cold plastic and metal. Placing an unthawed handset directly against lips or ears can cause physical injury.

Anticontact gloves should be available and used when touching cold metal equipment. Cold injury and loss of surface skin can occur after the briefest of contact with cold handles, knobs, and surfaces. Also, common tools, such as the TL-13A lineman's pliers, should have handles wrapped in plastic or tape to provide protection.

Spare connectors, cables, handsets, and antennas should be readily available for replacement when failures happen. Metals and plastic become remarkably brittle and crack and break easily in the cold. Friction tape is advised rather than plastic tape, which loses its adhesiveness in the cold.

Vehicular radios also require careful attention. Small physical shocks can cause whip antenna damage when in the upright position. Radios should be warmed for three to four minutes on low power before changing to high power settings or transmitting. The vehicle for the particular radio being used should be cycled periodically IAW its -10 series manual when temperatures dip below -30°F. The vehicle, when cycled, should be idled at approximately 1,200 RPM. Otherwise, the high discharge rate necessary to operate both the radio and the heater soon wears out vehicle batteries.

ANTENNA SYSTEMS

Attention to proper assembly of antennas is a commonly overlooked requirement in the cold and dark. Shortcuts and failure to follow prescribed instructions often result in interruption or degradation of communications and damage to equipment. The RC-292 and OE-254 antenna masts must be erected with enough sections to ensure necessary height.

Erecting

Standard stakes are often useless in frozen ground. GP-101 cold-weather stakes can be ordered for the RC-292, or the GP-112 for the OE-254. Because they are slimmer than standard stakes, they do not hold as well when the ground thaws. Heavy 12-inch steel tent pins have been used successfully. Tree and rock tie-offs are also acceptable. Another method for erecting an FM antenna is to guide the mast carefully alongside a tree and secure it to the trunk using one of the attached guy lines. Exercise care not to damage any of the elements, cable, or mast sections upon erecting.

Proper inventory of unused hardware is essential since parts are easily lost in snow and darkness. Care must also be taken not to let moisture accumulate due to condensation or precipitation and ground out the antenna against the trunk.

NOTE: Prior to assembly, expose antennas to the cold to prevent sweating and freezing. This prevents problems with disassembly.

Keep the mast sections clean and free of foreign matter. Lubricate the male and female ends of each mast section only with silicone lubricant. After applying the silicone and joining the sections, back off the joints by approximately one turn as a precaution against sticking.

The RG-213 coaxial cable is recommended over RG-8 cable; the latter becomes brittle and cracks at temperatures below -20°F. Spare cable connectors and adaptors are recommended, since damage and loss are common. Loop and tape coaxial antenna cable near the top of the mast to ease pressure on the connector. Tape the cable at intervals along the mast to prevent the whipping action of the wind from causing damage to the antenna. Tap the mast periodically to shake free snow and frost accumulation, which can degrade transmission signal strength. Make guy lines in a manner to prevent tripping on the antenna guys and disabling the antenna.

Keep ceramic bowls dry because water collects in them during warm weather. When temperatures drop, they freeze, causing the more brittle glass to crack. Applying silicone where the two bowl halves join assists in sealing against further cold damage.

Length

HF and long wire antennas can approach 75 meters in length, depending on the frequencies used. Attention to measurement is critical. The same applies to FM antennas. For the RC-292, the appropriate numbers of elements for radians and ground plan sections are given in Figure 6-1.

Orientation

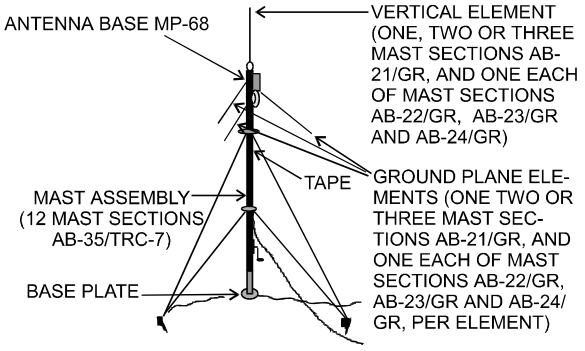
Orienting an azimuth is important and often difficult because of the requirement to compute large declination angles in northern latitudes. Directional antennas are often required to compensate for other conditions causing range degradation.

WIRE AND CABLE SYSTEMS

Laying wire over long distances in deep snow is greatly facilitated by the use of oversnow vehicles. These vehicles can also be the worst enemy of wire systems. Their skis and tracks damage surface-laid wire and cable that they pass over, dragging away large sections and cutting critical circuits. Standard wire-laying techniques, ties, and tagging apply in cold regions as well as in temperate zones. Aerial laying is advised when tactically feasible. Burial is desirable, but often difficult or impossible. Retrieving wire in cold regions is tedious and usually results in excessive salvage work due to ice and traffic damage. Stringing wire overhead is preferred because the wire will not freeze to the ground.

Wire insulation is often brittle, and impedance is increased in snow or damp conditions. Splices performed in the cold are often done improperly, and fewer can be allowed for continued use of serviced wire. A slack factor of 30 percent is recommended for wire-laying teams instead of the 20 percent suggested in the TM. This allows for cold weather shrinkage.

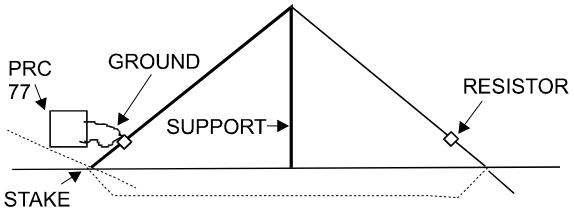
The TA-1/PT voice-powered telephone tends to perform poorly in extreme cold on wire of lengths extending beyond squad or platoon boundaries. The TA-312/PT, when powered by alkaline batteries (such as the BA-3030/U), provides reliable communications and is the preferred instrument for wire troubleshooting teams.



ANTENNA EQUIPMENT RC-292

RC-292 ANTENNA CONFIGATIONS

OPERATING FREQUENCY	Number of Antenna Sections Required	Type of Section Used				Number of Ground Plane Sections Required	Type of Ground Sections Per Element			
		AB 21/GR	AB 22/GR	AB 23/GR	AB 24/GR		AB 21/GR	AB 22/GR	AB 23/GR	AB 24/GR
20 to 27.9	6	3	1	1	1	18	3	1	1	1
27 to 38.9	4	1	1	1	1	15	2	1	1	1
38 to 54.4	3	0	1	1	1	12	1	1	1	1
30 to 36.5	4	1	1	1	1	15	2	1	1	1
36.5 to 50.5	3	0	1	1	1	12	1	1	1	1
50.5 to 75.9	2	0	1	1	1	9	0	1	1	1



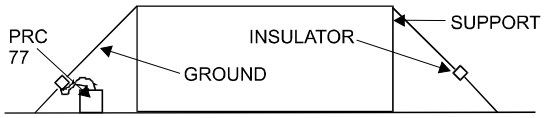
VERTICAL HALF RHOMBIC ANTENNA

Used with primarily with FM radios in lightly wooded areas.

Length.....	4 wavelengths of operating frequency, with a 11-meter lead-in.
Range.....	2 to 3 times normal range of set.
Height.....	13 wavelengths of operating frequency.
Resistor.....	400 to 700 ohms.

RADIATION WITHOUT RESISTOR

RADIATION WITH RESISTOR



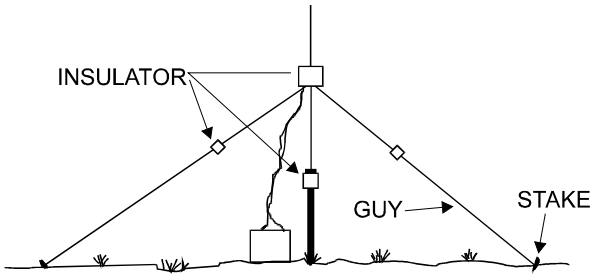
LONG WIRE ANTENNA

LONG WIRE ANTENNA. This antenna is used with both AM and FM radios to increase the range. It is normally used in open terrain where it can be constructed with ease.

Length.....	2 to 7 wavelengths of operating frequency.
Height.....	3 meters.
Range.....	2 to 3 times operating range of set
Resistor.....	400 to 700 ohms
Radation.....	WITHOUT resistor- off both ends of antenna. WITH resistor- off resistor end only.

RADIATION WITHOUT RESISTOR

RADIATION WITH RESISTOR



GROUND PLANE ANTENNA

Used with FM radios when the RC-292 Antenna is not available.

Length.....	Antenna Element.....2 meters Ground Plane Elements...2 ½ meters.
Range.....	Under most conditions will increase the range of set.
Height.....	Not to exceed 13 meters.

Figure 6-1. Antenna dimensions

Reeling wire and cable should be done carefully; reeled wire freezes into a coiled shape and should be warmed up before unreeling. The use of bigger coils also reduces the chances of pinches or breaks.

The newer type WD-1/TT field communications wire performs nearly as well in the cold as the old type of spiral wire. It is less durable and more susceptible to damage by vehicle traffic, however, and should be used in less traveled areas. The WD-36/TT assault wire is lighter and easier to handle, man-pack, dispense, and splice than WD-1/TT in the cold, but it is much less durable.

POWER SOURCES

Generators should be thoroughly inspected and winterized, since experience has shown that they develop a higher failure rate at sub-zero temperatures. This is attributable to outdated LOs, exposed batteries, and other elements. Follow these procedures for best results:

- Winterize the item using the correct cold weather lubricants.

- Move the air filter's intake shutter to WINTER when temperatures drop below freezing, so that warm manifold air keeps the carburetor from freezing up.

- Find a way to keep the battery warm, and prevent ice and snow from plugging battery cap vent holes. Keep one battery fully charged.

- Preheat using other heat sources when possible.

- Use the correct fuel icing inhibitor: technical methanol for gasoline; fuel system icing inhibitor for diesel fuel.

- Provide shelter so that the item provides its own heat. If a shelter is not available, use pallets or trailers to keep the generator off snow, ice, or frozen ground.

- Use correct idling and running speeds.

- Follow correct shutdown maintenance procedures.

- Use clean fuel and additives. A common problem is leaving expended fuel cans with caps off, allowing accumulation of snow and moisture in the can. This mistake eventually leads to icing in the fuel lines. Keep fuel tanks as full as possible to reduce condensation.

- Check, drain, and clean filters at least daily and at shutdown to prevent icing. Change oil more often in cold weather.

- Proper grounding of generators is important, but is seldom done satisfactorily. Perform expedient grounding by using an ice auger to cut through frozen surfaces, then submerge conductors in the water. TC 11-6, *Grounding Techniques*, is an excellent guide. If an area is used in summer and winter, bury a three-foot-square metal plate below the moisture line before the ground freezes. If its location is marked, it can be used when the earth is frozen. An existing ground, like an underground metal pipe, can be used as long as it is not for gas or flammable liquid. A cluster of short rods connected in parallel, or a long rod buried horizontally, can serve as a ground, as long as it reaches below the frostline. Ground rods work best if driven near a heat source, with a salt solution poured around it--about a pound of salt in a gallon of water.

COMPUTERS

Most computers are not designed to operate at extremely low temperatures and may become unreliable or unavailable for use (0°F for larger work stations, -30°F for small handheld devices). Liquid crystal displays (LCD), especially, may be affected by extreme

cold. Frozen knobs, dials, and switches should not be forced.

LCD displays can freeze or break below 32°F. When initially turned on, an LCD display in cold weather is faint and hard to read. If it is left on it will improve over time due to self warming.

NICAD computer batteries do not last as long in below 32°F weather. Charge rate for cold-soaked batteries is slower.